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Forecasting energy technology diffusion in space and time: model design, parameter choice and calibration

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Abstract-

New energy technologies such as Distributed Energy Resources (DER) will affect the spatial and temporal patterns of electricity consumption. Models that mimic technology diffusion processes over time are fundamental to support decisions in power system planning and policymaking. This paper shows that spatiotemporal technology diffusion forecasts consist typically of three main modules: 1) a global technology diffusion forecast, 2) the cellular module that is a spatial data substrate with cell states and transition rules, and 3) a spatial mapping module, commonly based on Geographic Information Systems. This work provides a review of previous spatiotemporal DER diffusion models and details their common building blocks. Analyzing 16 model variants of an exemplary spatial simulation model used to predict electric vehicle adoption patterns in Portugal, the analysis suggests that model performance is strongly affected by careful tuning of spatial and temporal granularities and chosen inference techniques. In general, model validation remains challenging, as early diffusion stages have typically few observations for model calibration.

Index Terms- Energy systems, technology diffusion, spatiotemporal simulation, power system planning, geographic information systems.

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